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RESOURCE CAPABILITIES AFFECTING SEDIMENTATION



Mini - Report

*MORLAR FLATS
PILOT STUDY AREA
Fresno County, California*

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RESOURCE CAPABILITIES AFFECTING
SEDIMENTATION MINI-REPORT

MORLAR FLATS
PILOT STUDY AREA
FRESNO COUNTY, CALIFORNIA

JULY 1978

Prepared by the

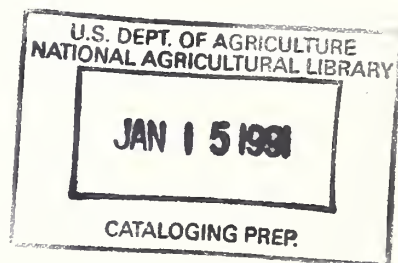
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RESOURCE CAPABILITIES AFFECTING SEDIMENTATION

MORLAR FLATS PILOT STUDY AREA

CHAPTER I - SUMMARY

There are two major land uses in the 4,650 acre Morlar Flats 208 Pilot Study Area. They include non-irrigated grazing and rangeland, which makes up 55 percent of the study area and rural residential sub-division, which makes up 42 percent of the study area. In the 1,960 acres comprising the sub-division, there are currently 85 developed lots, either occupied or suitable for occupation.

Soils of the area are placed in seven erodibility classes (K) with factors ranging from 0.15 to 0.37. The most predominant K factors present are 0.28, making up 31 percent of the study area and 0.17, making up 36 percent of the study area. None of the other classes individually exceed 18 percent of the study area. The study area has associated with it three soil tolerance (T) levels. The majority of the land, 63 percent, tolerates two tons/acre/year of soil loss. Rainfall (Rt) factors range from 25 to 50 over the area, with 53 percent of the land having an Rt of 30-40.

Included in the topographic study of the Morlar Flats Pilot Study Area are slopes, streams and roads. Much of the topography is characterized by steep slopes. Over 85 percent of the land has a slope greater than 15 percent, with the slope class of 45 percent plus, alone making up 47.5 percent of the area. Of the 12 miles of streams present, eight miles are second order, two miles are third order and two miles are fourth order. Nineteen miles of roads are present in the study area, with ten miles being county maintained light duty roads and nine miles being privately maintained light duty roads.

CHAPTER II - INTRODUCTION

The restoration and protection of water quality in the nation's streams represents the goal outlined in the Federal Water Pollution Control Act (Amendments of 1972). This Act requires the control of both municipal and industrial wastes (point sources) and diffuse sources of materials (non-point sources) which degrade water quality. The individual states have been charged with the task of preparing water quality management plans for those sources which discharge into streams and coastal waters under their jurisdiction.

In California, the task of preparing water quality management plans for non-point sources was assigned to the State Water Resources Control Board and the several Regional Water Quality Control Boards under Section 208 of PL 92-500. The approach of these water quality control boards is to identify problem areas which contribute pollutants to water.

Of the possible sources of water pollution cited by the Central Valley Regional Water Quality Control Board (Central Valley Regional Board), soil erosion was one. To study this problem in depth, the Soil Conservation Service (SCS) was selected to conduct studies which would determine local sources of erosion problems and recommend solutions to the Central Valley Regional Board. Studies in eight pilot study areas are now being conducted to determine the magnitude of the soil erosion problems in each area and to select the combination of practices which could best resolve them.

In order that the scheduled recommendations will be acceptable to local landowners, Local Management Teams have been organized for each of the pilot study areas by their affected Resource Conservation Districts. Concerns such as economics, impact on soil, crop and water management, and local institutional arrangements are all areas in which input from the Local Management Teams will be encouraged.

Each pilot study area was selected to represent a particular condition and its associated problems. These studies will be published in a series of mini-reports, of which this is the first.

One of the conditions implicated for degradation of downstream water quality by the SCS is the residential sub-divisions on foothill land. Morlar Flats is the pilot study area selected as representative of this condition. The change in land use from grazing and rangeland to residences and mini-farms is characterized by an extensive increase in roads, steep cuts and fills, vegetative cover loss and a loss of absorptive capacity due to various forms of compaction. These factors are expected to increase rates of runoff, erosion and sedimentation of streams.

Prior to 1973, the land was treated as range. The slopes were largely foothill woodland with flats being more open. Year-round cow-calf operations exerted a light grazing pressure on the forage. Generally, the forage cover was maintained in accordance with the current standards, with management techniques employed to optimize foraging. This generally increased the soil's resistance to the forces of erosion.

In 1973, a large part of the Baker-Hall Ranch was sub-divided into lots varying in size from five to ten acres. The developer constructed roads and began sales. The lot owners have since developed their properties into residential units. This involved cutting and filling in the slopes in order to have a level surface for the placement of mobile homes. On many of the lots, development stopped after construction of the house pad. In addition, other land and vegetation modifications have occurred to accommodate corrals, home gardens and orchards, driveways and parking areas. Vegetative treatments have varied from undisturbed range to rather complete ornamental planting or complete denudation.

The pilot study area is a watershed that drains into an unnamed, intermittent stream which joins Mill Creek at the community of Dunlap in Fresno County. Mill Creek is a major tributary joining the Kings River just downstream of the Pine Flat Storage Dam, the major flood control and irrigation water storage facility on the river. The watershed includes 4,650 acres in Township 14 S, Range 26 E, Mount Diablo Base and Meridian.

In order to better understand the nature and characteristics of the land being studied, seven general factors are considered. They are: soils, land use, topography, farming methods and practices and major roads and streams in the area. In the Water Quality Planning Study, these factors were used to help designate eight different pilot study areas which would be representative of the overall Valley Region.

The soils in the Morlar Flats Pilot Study Area may be grouped into three major classifications.

1. Alluvial soils of the valley floor makes up 5 to 6 percent of the area. They are deep, predominantly sandy loams, with good drainage. Slopes are predominantly flat, with a few gently sloping (3 to 9 percent) areas of limited extent.
2. Residual soils formed on basic igneous and metamorphic rocks are moderately deep with surface textures of fine sandy loam or loam. About 41 percent have slopes of 10 to 20 percent and 59 percent are steeper. These soils make up about 20 percent of the total area.
3. The remainder of the area has residual soils formed on granite rocks. The surface soils are medium to coarse sandy loams over sandy loam to clay loam subsoils and weathered rock. They range in depth from deep (4' +) to very shallow. About 6 percent of

these soils are classified as "Rock land." Twenty-eight percent of these soils occur on slopes of 10 to 30 percent, with about 70 percent steeper (3)¹.

The pilot study area is composed of a watershed which has three areas and a number of subwatersheds with well defined drainage courses. It is rimmed by ridges of 2,500 to 3,000 feet mean sea level (MSL) around floors sloping from 2,300 to 2,100 feet MSL. The exit is a fairly steep canyon dropping from 2,100 to 1,850 feet in a mile and a quarter. Two passes of 2,300 feet MSL are utilized by Sand Creek and Ruth Hill roads. Within the watershed, land slopes of 0 to 3 percent are found on the alluvial floors (5 to 6 percent of watershed area), rolling land (3 to 30 percent slope) takes up about 30 percent and the remainder is steep with slopes above 30 percent. The area with the most development is V-bottomed, oriented from southeast to northwest. It occupies about one-half of the watershed and joins the other two areas with drainages flowing easterly. It then exits northerly to Mill Creek.

The study area is non-irrigated, grazing and rangeland. The cover type and land use treatment now consists of three major groupings: 1. grazed rangeland; 2. ungrazed rangeland (sold to subdivider but not yet developed); and 3. the sub-division area undergoing development.

The remaining land is left "natural" on some properties, grazed by horses, cattle and/or sheep, or "mini-farmed" with small orchards, vegetable gardens, etc., according to the inclination of each owner. Because of the limited area available, mini-ranches with horses or livestock are usually over-grazed. These pastures are in reality corrals or holding pens without much opportunity for management. Many of the larger gardens and orchards are "farmed" by the methods suited to field and truck crops of the valley floors. When tractors are available, rows are generally straight without regard to the slope and open tilled for weed control. The net effect of these practices is a greatly increased soil disturbance and a lessened effective soil cover during, and often following, construction. These factors have an accumulative effect on the quality of runoff water.

In contrast to this, the undisturbed portions of the sub-divisions are not contributing directly to any soil erosion problem. However, because of the thick cover developing in many places, a potential for wildfire may exist. This can be an indirect source of soil erosion. The land outside the sub-division is grazing land or rangeland and managed according to usual standards of the region. Stocking rates are balanced to the average forage.

¹ Numbers in parentheses refer to the References on page 24. Please refer to this page for all future numbers in parentheses.

Access to the area is by two minor county roads. Sand Creek Road runs through the middle of the watershed connecting the City of Orange Cove on the south to Miramonte, a small foothill community centered around an elementary school and combination grocery-service station-post office. Ruth Hill Road parallels Highway 180 and serves the rural residents between Dunlap and Squaw Valley. A short link, Sans Baker Road, joins the two, wholly within the watershed. A network of sub-division roads, only a few of which are in the county system, gives access to each lot from Sand Creek Road. The sub-division roads are paved, but many do not meet all standards for acceptance into the county system.

There are no major streams in the study area. All runoff moves in a network of unnamed intermittent streams which discharges into Mill Creek at Dunlap. Mill Creek is (usually) a perennial tributary of the Kings River, joining it near the community of Piedra, downstream from the Pine Flat Storage Dam.

CHAPTER III - RESOURCE CAPABILITY INVENTORY

BASIC DATA

In order to emulate the effect of soil erosion and sedimentation on water quality at Morlar Flats, it was necessary to first estimate the amount of sediment that is expected to be produced annually and delivered to the drainage system. Some of the information used in the calculations that predict erosion rates and sediment yield were already known for the entire study area from previous surveys. Others needed to be determined from field measurement or evaluation.

Because of the time and manpower limitations, the field work had to be restricted to a portion of the study area, covering about 5 percent of the total. The convenient size of the sampling sites was chosen to be 40 acres. Division of the total acreage by 40 gave the number of sampling sites or plots.

This report contains orderly assemblages of already available data in the forms of maps and tables. The data is composed of numerical values when appropriate and areal distributions of parameters (assigned qualitative values used to describe particular qualities of soil). Both are used in the selection of sites to ensure as representative a sampling as possible. The various parameters from which the data was assembled are presented in the following section, together with a brief commentary on their role and purpose, relative to the overall study.

The basis for all map preparation was the current U.S.G.S. quadrangle ($7\frac{1}{2}$ minutes--1:24,000 scale) topographic maps. Map measurements were made by planimetering and scaling directly from reproductions. Aerial photography was used for interpretative use in making the land use map determining gullies and landslide areas.

One of the methods of using data which has been applied throughout the survey is to extrapolate data and to apply it to the entire study area.

Land Use

Because an association exists between land use characteristics and rates of erosion, land use was selected as a guiding factor for selecting sampling sites. Distribution of those sites according to land use provides for a simple and rational means of using on-site measured data to be representative over an entire study area.

The different land uses in the area are represented on Map 1. Maps were used to determine specific areas in acres associated with each land use. The various land uses in the study area, together with their descriptions, are listed in Appendix A.

A summary of the acreages of specified land use is shown in Table 1.

Soil Erodibility Factor (K)

The soil erodibility or K factor is a measure of the susceptibility of a given soil to erosion by rainfall. All the soils in the Morlar Flats study area have already been mapped and assigned K factor values (3). The soil survey map of Eastern Fresno area was used as the basis for preparing a new K factor map specifically for the Morlar Flats study area (Map 2). This map was able to serve the dual purpose of providing the area's K values for the estimation of erosion rates by rainfall and in guiding the selection of sampling sites.

Areas associated with each class of K value were measured from the map and listed in Table 3. It is evident from the table that the predominant class of K is 0.17, with an area of 1,660 acres (36 percent of total). Next in importance is K class 0.28 with 1,450 acres (31 percent of total). High K values indicate a soil with a high potential for erosion.

Table 1. LAND USE, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Land Use	Pilot Study Area		Percent of Total
	(Acres)	(Ha)	
Non-Irrigated Grazing and Rangeland	2,560	1,040	55.0
Transportation Service	130	50	3.0
Other	1,960	800	42.0
Totals	4,650	2,100	100.0

Table 2. SOIL SURVEY INTERPRETATIONS OF EROSION FACTORS, MORLAR FLATS
"208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Map Symbol	Soil Name	Soil Erodibility (K) Factor	Soil Loss Tolerance (T) Factor
AcB	Ahwahnee coarse sandy loam, 3-9% slopes	0.15	2
AcC	Ahwahnee coarse sandy loam, 9-15% slopes	0.15	2
AcD	Ahwahnee coarse sandy loam, 15-30% slopes	0.15	2
AdD	Ahwahnee very rocky coarse sandy loam, 3-30% slopes	0.15	2
AkF	Ahwahnee-Tollhouse-Rock land complex, 45-70% slopes	0.15	2
AuB	Auberry coarse sandy loam, 3-9% slopes	0.17	2
AuC	Auberry coarse sandy loam, 9-15% slopes	0.17	2
AuD	Auberry coarse sandy loam, 15-30% slopes	0.17	2
AuE	Auberry coarse sandy loam, 30-45% slopes	0.17	2
AvD	Auberry very rocky coarse sandy loam, 3-30% slopes	0.17	2
AvE	Auberry very rocky coarse sandy loam, 30-45% slopes	0.17	2
AvF	Auberry very rocky coarse sandy loam, 45-70% slopes	0.17	2
AxC	Auberry-Sierra coarse sandy loams, 30-45% slopes	0.17	2
CtB	Chualar sandy loam, 3-9% slopes	0.15	5
CxF	Coarsegold fine sandy loam, 45-70% slopes	0.32	3
GrF	Granitic rock land	0.28	5
GtB	Greenfield sandy loam, 3-9% slopes	0.15	5
HwA	Honcut fine sandy loam, 0-3% slopes	0.24	3
LbB	Los Robles sandy loam, 2-9% slopes	0.28	5

Table 2. SOIL SURVEY INTERPRETATIONS OF EROSION FACTORS, MORLAR FLATS
 "208" PILOT STUDY AREA, FRESNO COUNTY, 1978 - CONTINUED

Map Symbol	Soil Name	Soil Erodibility (K) Factor	Soil Loss Tolerance (T) Factor
ImB	Los Robles loam, 3-9% slopes	0.32	5
SkB	Sesame sandy loam, 3-9% slopes	0.28	2
SnC	Sierra sandy loam, 9-15% slopes	0.28	5
SnE	Sierra sandy loam, 30-45% slopes	0.28	5
SoD	Sierra very rocky sandy loam, 3-30% slopes	0.28	5
SoE	Sierra very rocky sandy loam, 30-45% slopes	0.28	5
SoF	Sierra very rocky sandy loam, 45-70% slopes	0.28	5
ToC	Trabuco loam, 9-15% slopes	0.37	2
ToE	Trabuco loam, 30-45% slopes	0.37	2
ToF	Trabuco loam, 45-70% slopes	0.37	2
TpF	Trabuco very rocky loam, 45-70% slopes	0.37	2
TvC	Tretten fine sandy loam, 3-15% slopes	0.32	2
TvD	Tretten fine sandy loam, 15-30% slopes	0.32	2
TvF	Tretten fine sandy loam, 45-70% slopes	0.32	2
TwF	Tretten very rocky fine sandy loam, 45-70% slopes	0.28	2
VaA	Visalia sandy loam, 0-3% slopes	0.20	5
VaB	Visalia sandy loam, 3-9% slopes	0.20	5
WhD	Wisheylu loam, 9-30% slopes	0.32	2

Table 3. SOIL ERODIBILITY (K) FACTOR AREAS, MORLAR FLATS "208"
PILOT STUDY AREA, FRESNO COUNTY, 1978.

Soil Erodibility (K) Factor	Pilot Study Area		
	(Acres)	(Ha)	Percent of Total
0.15	240	100	5.0
0.17	1,660	670	36.0
0.20	250	100	5.5
0.24	20	10	0.5
0.28	1,450	590	31.0
0.32	840	340	18.0
0.37	190	80	4.0
Totals	4,650	1,890	100.0

Rainfall (Rt) Factor

As rainfall provides the major force from which soil erosion results, a measure of it must be included in any analysis of the potential for soil erosion. R factors have been developed which indicate the effect of rainfall in a given area on the potential soil erosion rates. This factor takes into account not only total amounts of rainfall, but also the intensity of the rainfall and the seasonal distribution of storms. In areas where snowmelt producing runoff contributes a significant part to erosion, the overall effect is represented by the combined factor (Rt).

Rainfall Frequency Maps issued by the National Oceanic and Atmospheric Administration were utilized to portray isopluvials (a line on a map connecting points of equal rainfall amounts) of 2 year, 6 hour rainfall on the study area maps(2). The data on these maps was next converted into Rt values by the method described in Guides for Erosion and Sediment Control in California(4). Areas associated with the three ranges of Rt values in the study area were measured on Map 3 and listed on Table 4.

The predominant value of Rt in the study area is in the 30 to 40 range (2,460 acres or 53 percent). See Map 3 and Table 4 for further information on amounts and locations.

Table 4. RAINFALL (Rt) FACTOR AREAS, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Rainfall (Rt) Factor	Pilot Study Area		Percent of Total
	(Acres)	(Ha)	
25-30	1,100	450	23.5
30-40	2,460	1,000	53.0
40-50	1,090	440	23.5
Totals	4,650	1,890	100.0

Slope Steepness

Slope is another factor that influences the potential for a given area to experience soil erosion. As the slope of the land affects the tendency for a given amount of soil to move downward by force of gravity, it is a factor that influences rates of water runoff and, hence, rates of erosion and sedimentation.

Available slope steepness data for the entire study area was assembled from past soil surveys and represented on Map 4, which identifies not only soil type, but a slope class associated with all areas. The total area was then divided into segments according to the slope steepness classes shown in Appendix D. Each segment was labeled with the associated code symbol.

Table 5 shows that the majority of the study area, roughly 70 percent, has slopes of greater than 30 percent. This breaks down into 2,210 acres (47.5 percent) with slopes greater than 45 percent and 930 acres (21 percent) with slopes in the range of 30 to 45 percent. See Map 4 and Table 5 for further information on amounts and locations.

Table 5. SLOPE AREAS, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Slopes (%)	Pilot Study Area		Percent of Totals
	(Acres)	(Ha)	
0-3	40	20	1.0
3-9	310	130	7.0
9-15	290	120	6.0
15-30	820	330	17.5
30-45	980	400	21.0
45+	2,210	890	47.5
Totals	4,650	1,890	100.0

Soil Loss Tolerance Factor (T)

Soil loss tolerance (T), sometimes called permissible soil loss, is the maximum rate of soil erosion (whether from rainfall or wind) that will permit a high level of crop productivity to be sustained economically and indefinitely. T factors of 1 through 5 are used.

The numbers represent the permissible tons of soil loss per year. The T factor is used in the soil loss prediction equations for rainfall and for wind erosion. The same T factors are used for each equation and are not additive if both rainfall erosion and wind erosion occur on the same soil.

T factor has a relationship to the rooting depths of a soil and, therefore, is a factor in determining some conservation practices for a given land use.

As a first step, existing data from the Eastern Fresno Area Soil Survey, 1971, was used to prepare a T factor map (Map 5). Measurement of areas having the same value was made.

The data from the measurement that was compiled in Table 6 shows that 2,930 acres, or 63 percent of the study area, have a tolerable soil loss of two tons/acre/year.

Table 6. ALLOWABLE SOIL LOSS TOLERANCE (T) FACTOR AREAS, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Soil Loss Tolerance (T) Factor	Pilot Study Area		
	(Acres)	(Ha)	Percent of Total
2	2,930	1,190	63.0
3	160	70	3.5
5	1,560	630	33.5
Totals	4,650	1,890	100.0

Vegetal Cover

It is an indicator of potential erosion, but because of the difficulty in describing it numerically, it cannot be used directly in arriving at estimates by computational methods. Its evaluation is descriptive as shown in Appendix F and, particularly important, in non-crop lands; such as range. In general, areas of different type of cover can be delineated on a map, which in turn is used to extrapolate data from sampling sites to the entire area.

In the case of the Morlar Flats study, preparation of a vegetal cover map was not necessary because the entire land is covered by the single type of hardwoods and grasses (HG).

This type is defined as areas in which the crown canopy of broad-leaved tree species cover 20 to 50 percent of the ground space with grass and forbs covering at least 20 percent of the ground space. Species include principally oaks, grasses and forbs.

Stream Orders

Stream ordering is a technique of classifying the elements of a drainage network. It is helpful to sedimentation studies in the following ways: It provides a basis for the estimation of the delivery ratio, which is the ratio of the sediment delivered to a certain point on the network to the amount generated at the source; it helps in the selection of the sampling sites, at which actual rates of streambank erosion are to be measured or estimated; and finally, it helps in the generalization of the results obtained from on-site measurement.

A stream order map was prepared for the Morlar Flats study area. Data on the stream length and stream density by stream orders measured on Map 6 are shown in Tables 7 and 8, respectively.

Items of particular interest in the two tables are that the total length of streams in the study area is 12 miles; the majority of these streams, comprising eight miles, are second order; and their density is 1.1 miles per square mile of the study area.

Transportation Facilities

Water induced erosion within the construction and maintenance boundaries of transportation facilities (such as highways, roads, etc.) is the result of different processes than those causing erosion on agricultural lands. For this reason, this type of erosion is being treated separately here.

In order to help the selection of sampling sites on which actual measurement of erosion could be made and the generalization of results from such measurements, a transportation facilities map was prepared (see Map 7).

Measurement on the map by direct scaling revealed that there are 19 miles of roadway in the study area. Out of the total, ten miles are county maintained, light duty roads and nine miles , privately maintained, light duty roads (Table 9).

SELECTION OF SAMPLE SITES

Sheet and rill erosion is the most predominant type of erosion expected in the study area. Sheet erosion describes the removal of a fairly uniform layer of soil from the land surface by runoff water. Rill erosion is a process in which numerous small channels of only several inches in depth are formed. Because it is very difficult to survey the entire study area for soil erosion, it was decided to use a system of representative sampling. Based on on-site measurements, this system would describe the extent of any problem. The data derived from these sample sites will later be projected over the entire study area. Five percent of the total study area was determined to be an adequate sample size for describing sheet and rill erosion.

To adequately describe the extent of the soil erosion problem of Morlar Flats, it was decided that the sample sites selected must be of two sizes. One size of sample site is required to estimate erosion rates on rangeland and on land in the sub-division, exclusive of the house pads themselves. This information will characterize soil erosion on rangeland and give a background value for the sub-division. The other size of sample site will consist of an entire house pad and its associated property rights and by necessity be much smaller. Samples of the former type are called macro samples and of the latter, micro samples.

Table 7. STREAM LENGTHS BY STREAM ORDER, MORLAR FLATS "208"
PILOT STUDY AREA, FRESNO COUNTY, 1978.

Stream Order	Pilot Study Area	
	(Miles)	(Km)
2	8	13
3	2	3
4	2	3
Totals	12	19

Table 8. STREAM DENSITY BY STREAM ORDER, MORLAR FLATS "208"
PILOT STUDY AREA, FRESNO COUNTY, 1978.

Stream Order	Pilot Study Area	
	Mi/Sq Mi	Km/Sq Km
2	1.1	0.7
3	0.3	0.2
4	0.3	0.2

Table 9. TRANSPORTATION FACILITIES, MORLAR FLATS "208" PILOT
STUDY AREA, FRESNO COUNTY, 1978.

Transportation Facility	Pilot Study Area	
	(Miles)	(Km)
<u>City/County Maintained</u>		
Light Duty Road	10	16
<u>Privately Maintained</u>		
Light Duty Road	9	14
Totals	19	30

Five percent of the total study area was considered to be an adequate coverage for data derived from the macro samples. With a total study area of 4,650 acres, 230 acres would be sampled. By using individual 20-acre sample sites, 11 sample sites were required. The sample sites were distributed throughout the study area to maximize coverage on the parameters previously discussed. This distribution took into account the variability in areal sizes of each of the factors; for example, rangeland and grazing comprise 2,560 acres of the study area. A 5 percent coverage of this requires a sample area of 130 acres (5 percent of 2,560 = 130). Therefore, at least seven sample sites of 20 acres each is indicated to give a complete 5 percent coverage.

Tables 10 through 14 demonstrate how macro sample sites have been distributed according to each factor discussed under land use, K factor, T factor, Rt factor and slope class. For each factor listed, 5 percent of its areal extent, number of samples, area of sample and percent of area sampled relative to the 5 percent areal extent is listed; for example, K factor = 0.32, 5 percent of area = 40 acres, number of samples = 2, area sampled = 40 acres, percent relative to 5 percent areal extent = 100. This last figure is a measure of the extent to which the 5 percent "goal" is attained.

Table 15 presents each macro sample site individually and lists K factor, T factor, Rt factor and slope class associated with it. Map 8 shows the location of each of the macro sample sites.

Because the soil erosion problem on the house pads is a more complex problem, it was decided to sample approximately 25 percent of the existing house pads (micro sample sites). The micro sample sites were chosen randomly, using a random numbers table.

Tables 16 through 19 document the relative distribution of micro sample sites according to each factor discussed under K factor, T factor, Rt factor and slope class. For each factor listed, the total number of homesites present, the number selected as micro sample sites and the percent of the micro sample sites selected relative to the total number present for that factor are listed.

Table 20 presents each micro sample site individually and lists K factor, T factor, Rt factor and slope class. Map 9 shows the location of each of the micro sample sites.

Table 10. DISTRIBUTION OF MACRO SAMPLE SITES BY LAND USE, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Land Use	5 Percent of Area	Sample Sites Selected	Area of Sample	Percent of Area Sampled Relative to 5 Percent Goal
Non-Irrigated Grazing and Rangeland	130	5	100	77.0
Transportation Service	10	a	130	1,300.0
Other	100	6	120	120.0
Totals	240	11	350	150.0

Table 11. DISTRIBUTION OF MACRO SAMPLE SITES BY SOIL ERODIBILITY (K) FACTORS, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978

Soil Erodibility (K) Factor	5 Percent of Area	Sample Sites Selected	Area of Sample	Percent of Area Sampled Relative to 5 Percent Goal
0.15	10	1	20	200.0
0.17	80	4	80	100.0
0.20	10	0	0	---
0.24	a	0	0	---
0.28	70	4	80	114.5
0.32	40	2	40	100.0
0.37	10	0	0	---
Totals	220	11	220	100.0

a = Area of 5 acres or less.

Table 12. DISTRIBUTION OF MACRO SAMPLE SITES BY SOIL LOSS TOLERANCE (T) FACTORS, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Soil Loss Tolerance (T) Factor	5 Percent of Area	Sample Sites Selected	Area of Sample	Percent of Area Sampled Relative to 5 Percent Goal
2	150	7	140	93.5
3	10	1	20	200.0
5	80	3	60	75.0
Totals	240	11	220	91.5

Table 13. DISTRIBUTION OF MACRO SAMPLE SITES BY RAINFALL (Rt) FACTORS, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Rainfall (Rt) Factor	5 Percent of Area	Sample Sites Selected	Area of Sample	Percent of Area Sampled Relative to 5 Percent Goal
25-30	60	2	40	66.5
30-40	120	6	120	100.0
40-50	50	3	60	120.0
Totals	230	11	220	95.5

Table 14. DISTRIBUTION OF MACRO SAMPLE SITES BY SLOPE AREAS,
MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY,
1978.

Slopes	5 Percent of Area	Sample Sites Selected	Area of Sample	Percent of Area Sampled Relative to 5 Percent Goal
0-3	a	0	---	-----
3-9	20	1	20	100.0
9-15	10	0	---	-----
15-30	40	2	40	100.0
30-45	50	3	60	120.0
45+	110	5	100	90.5
Totals	230	11	220	95.5

a = Area of 5 acres or less.

Table 15. MACRO SAMPLE SITES, MORLAR FLATS "208" PILOT STUDY AREA,
FRESNO COUNTY, 1978.

Sample Site	Land Use	Soil Erodibility (K) Factor	Soil Loss Tolerance (T) Factor	Rainfall (Rt) Factor	Slopes
MA 1	Non-Irrigated Grazing and Rangeland	0.32	3	25-30	45+
MA 2	Non-Irrigated Grazing and Rangeland	0.15	2	25-30	45+
MA 3	Non-Irrigated Grazing and Rangeland	0.32	2	30-40	3-9
MA 4	Non-Irrigated Grazing and Rangeland	0.17	2	30-40	30-45
MA 5	Non-Irrigated Grazing and Rangeland	0.17	2	30-40	30-45
MA 6	Other	0.17	2	30-40	15-30
MA 7	Other	0.28	5	30-40	30-45
MA 8	Other	0.28	5	30-40	45+
MA 9	Other	0.28	5	40-50	45+
MA 10	Other	0.17	2	40-50	15-30
MA 11	Other	0.28	2	40-50	45+

Table 16. DISTRIBUTION OF MICRO SAMPLE SITES BY SOIL ERODIBILITY (K) FACTOR, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Soil Erodibility (K) Factor	Homesites Present	Homesites Selected (Micro Sample Sites)	Percent of Homesites Selected
0.15	0	0	---
0.17	48	15	31.5
0.20	1	1	100.0
0.24	0	0	---
0.28	40	6	15.0
0.32	0	0	---
0.37	0	0	---
Totals	89	22	25.0

Table 17. DISTRIBUTION OF MICRO SAMPLE SITES BY RAINFALL (Rt) FACTORS, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Rainfall (Rt) Factor	Homesites Present	Homesites Selected (Micro Sample Sites)	Percent of Homesites Selected
25-30	0	---	---
30-40	39	8	20.5
40-50	50	14	28.0
Totals	89	22	25.0

Table 18. DISTRIBUTION OF MICRO SAMPLE SITES BY SLOPES, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Slopes (%)	Homesites Present	Homesites Selected (Micro Sample Sites)	Percent of Homesites Selected
0-3	0	---	---
3-9	1	0	---
9-15	8	2	25.0
15-30	20	7	35.0
30-45	38	10	26.5
45+	22	3	13.6
Totals	89	22	25.0

Table 19. DISTRIBUTION OF MICRO SAMPLE SITES BY SOIL LOSS TOLERANCE (T) FACTORS, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Soil Loss Tolerance (T) Factor	Homesites Present	Homesites Selected (Micro Sample Sites)	Percent of Homesites Selected
2	54	15	28.0
3	0	--	---
5	35	7	20.0
Totals	89	22	25.0

Table 20. MICRO SAMPLE SITES, MORLAR FLATS "208" PILOT STUDY AREA, FRESNO COUNTY, 1978.

Homesite Number	Soil Erodibility (K) Factor	Soil Loss Tolerance (T) Factor	Rainfall (Rt) Factor	Slopes
2	0.28	5	30-40	45+
3	0.17	5	30-40	15-30
5	0.17	2	30-40	30-45
9	0.17	2	30-40	30-45
12	0.17	2	30-40	30-45
16	0.20	5	30-40	30-45
22	0.17	2	40-50	30-45
103	0.17	2	40-50	30-45
108	0.28	5	40-50	30-45
113	0.17	2	40-50	30-45
114	0.17	2	40-50	15-30
117	0.17	2	40-50	30-45
118	0.17	2	40-50	15-30
123	0.28	5	40-50	45+
129	0.17	2	40-50	30-45
204	0.28	5	40-50	45+
209	0.28	5	40-50	15-30
211	0.17	2	40-50	9-15
212	0.17	2	40-50	9-15
213	0.17	2	40-50	15-30
307	0.17	2	30-40	15-30
503	0.28	5	30-40	30-45

REFERENCES

1. LI, Jerome C. R., Statistical Inference I, Edwards Brothers, Inc., Ann Arbor, Michigan, 1964.
2. NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (U. S. Department of Commerce), Precipitation Frequency Maps for California, December 1972.
3. SOIL CONSERVATION SERVICE, (U. S. Department of Agriculture), Soil Survey of Eastern Fresno Area, California, October 1971.
4. SOIL CONSERVATION SERVICE, (U. S. Department of Agriculture), Guides for Erosion and Sediment Control in California, January 1975.

APPENDICES

APPENDIX A

LAND USE MAP LEGEND

- NG. NON-IRRIGATED GRAZING-RANGELAND: Non-irrigated land used primarily for the production of non-planted forage plants grazed by livestock and big game animals and which does not produce wood commodities.
- TS. TRANSPORTATION SERVICES: Land use primarily for highways, roads, beltways, railroads, utility rights-of-way, airports and other transportation facilities, together with necessary adjacent facilities; such as, approaches, underground and surface utilities, and other servicing structures, appurtenances and measures.
- X. OTHER: Land not classified in any of the above categories.

APPENDIX B

SOIL ERODIBILITY (K) FACTOR MAP LEGEND

Soil areas judged to have soil erodibility factor (K) values:

.15 Of at least .13 but not more than .15

.17 Of at least .16 but not more than .18

.20 Of at least .19 but not more than .21

.24 Of at least .22 but not more than .25

.28 Of at least .26 but not more than .29

.32 Of at least .30 but not more than .34

.37 Of at least .35 but not more than .39



——— Watershed Boundary

(blank) Miscellaneous areas not classified.

APPENDIX C

RAINFALL (Rt) FACTOR MAP LEGEND

Areas with mean annual rainfall intensity factor (Rt) values:

10	— . . —	Not exceeding 12
15	— . . —	Of at least 13 but not more than 17
20	— . . —	Of at least 18 but not more than 22
25	— . . —	Of at least 23 but not more than 27
30	— . . —	Of at least 28 but not more than 34
40	— . . —	Of at least 35 but not more than 34
50	— . . —	Of at least 45 but not more than 54
60	— . . —	Of at least 55 but not more than 64
70	— . . —	Of at least 65 but not more than 74
80	— . . —	Of at least 75 but not more than 84
90	— . . —	Of at least 85 but not more than 94
100	— . . —	Of 95 or greater
16		Average Annual Precipitation
W		Water
		Watershed Boundary

APPENDIX D

SLOPE MAP LEGEND

- A 0 to 3 PERCENT: Areas in which the average slope of the land is not more than 3 percent above horizontal. Includes not more than 10 percent of areas with average slopes greater than 3 percent.
- B 3 to 9 PERCENT: Areas in which the average slope of the land ranges from 3 to 9 percent above horizontal. Includes not more than 10 percent and greater than 9 percent.
- C 9 to 15 PERCENT: Areas in which the average slope of the land ranges from 9 to 15 percent above horizontal. Includes not more than 10 percent of areas with average slopes less than 9 percent and greater than 15 percent.
- D 15 to 30 PERCENT: Areas in which the average slope of the land ranges from 15 to 30 percent above horizontal. Includes not more than 10 percent of areas with average slopes less than 15 percent and greater than 30 percent.
- E 30 to 45 PERCENT: Areas in which average slope of the land ranges from 30 to 45 percent above horizontal. Includes not more than 20 percent of areas with average slopes less than 30 percent and greater than 45 percent
- F ABOVE 45 PERCENT: Areas in which the average slope of the land is greater than 50 percent above horizontal. Includes not more than 20 percent of areas with average slopes less than 45 percent.

APPENDIX E

SOIL LOSS TOLERANCE (T) FACTOR MAP LEGEND

Soil areas judged to have a soil loss tolerance of:

1 1 ton per acre per year

2 2 tons per acre per year

3 3 tons per acre per year

4 4 tons per acre per year

5 5 tons per acre per year

W Water

———— Watershed Boundary

(blank) Miscellaneous areas not classified

APPENDIX F

VEGETAL COVER MAP LEGEND

- CF CONIFEROUS FOREST: Areas in which the crown canopy of conifer tree species covers more than 10 percent of the ground space. Species include pine, true fir, Douglass fir, redwood, incense cedar. Does not include pinyon pine or junipers.
- PJ PINYON JUNIPER: Areas in which the crown canopy of single-leaf pinyon pine or California juniper, alone or together, covers more than 5 percent of the ground space and not classified Coniferous Forest or Hardwood Forest.
- GF GRASS AND FORBS: Mountain meadows and non-irrigated areas in which grasses and forbs cover more than 50 percent of the ground space or more space than the crown canopy of shrubs and not classified Coniferous Forest, Hardwood Forest, Chaparral and Mountain Brush, Pinyon-Juniper or Hardwoods and Grass. Annual species include California wild oats, bromes, fescuess, clover, California bur-clover, vetches and filarees. Perennial species include needle-grasses, oatgrasses, bluegrasses, desert saltgrass, alkali sacaton, squirreltail and Western yarrow (*Achillea*).
- SS SOUTH DESERT SHRUB: Areas in which the crown canopy of shrubs characteristic of the Mojave and Colorado Deserts covers more than 5 percent of the ground space and not classified North Desert Shrub, Pinyon-Juniper or Chaparral and Mountain Brush. Species include cacti, Joshua tree, yuccas, bursage, ironwood, mesquite, saltbush, creosote bush.
- CS COASTAL SAGEBRUSH: Areas in which the crown canopy of shrub species including California sagebrush, Black sage, California buckwheat, White sage, Purple sage, Bush senecio and Chaparral Broom cover more than 50 percent of the ground space or more space than exposed herbaceous cover and not classified Hardwoods and Grass, Pinyon-Juniper, North Desert Shrub or South Desert Shrub. Plants are generally low in stature, slenderly branched, grayish, found on lower, dry foothills of Coast Range.
- HG HARDWOODS AND GRASS: Areas in which the crown canopy of broad-leaved tree species cover 20 to 50 percent of the ground space with grass and forbs covering at least 20 percent of the ground space and not classified Coniferous Forest, Hardwood Forest or Chaparral and Mountain Brush. Species include principally oaks, grasses and forbs.

APPENDIX F (CONTINUED)


- HF HARDWOOD FOREST: Areas in which the crown canopy of broad-leaved tree species covers more than 50 percent of the ground space and not classified Coniferous Forest. Species include oaks, California Bay, madrone, tanoak, cottonwood, alder and sycamore.
- CB CHAPARRAL AND MOUNTAIN BRUSH: Areas in which the crown canopy of shrub species, including manzanita, ceanothus, sage, mountain mahogany, chamise, redshank and scrub oak covers more than 50 percent of the ground space or more space than exposed herbaceous cover and not classified Coniferous Forest or Hardwood Forest. Plants are generally tall in stature and heavily branched.
- NS NORTH DESERT SHRUB: Areas in which the crown canopy of shrubs characteristic of the Great Basin, which are generally low in stature and slenderly branched, cover more than 5 percent of the ground space and not classified Chaparral and Mountain Brush, Pinyon-Juniper, Coastal Sagebrush or Hardwoods and Grass.
- W WATER: Includes permanent inland water surface (such as lakes, ponds and reservoirs having an area of 40 acres or more; streams, sloughs, estuaries and canals 1/8 of a statute mile or more in width.
- X OTHER: Areas which are not classified in any of the above categories. Examples are cultivated and pasture, urban-industrial, and barren areas.


APPENDIX G


STREAM ORDER MAP LEGEND

- 2 Second order stream reach is the uppermost stream reach delineated by a blue line on the standard U. S. Geological Survey 1:24,000 scale topographic quadrangle map or, if not available, then on a 1:62,500 scale quadrangle map that continues downstream to the junction with the next stream.
- 3 Third order stream reach beginning at the junction of two second order streams and continuing downstream to the junction with the next third order stream.
- 4 Fourth order stream reach beginning at the junction of two third order streams and continuing downstream to the junction with the next fourth order stream.
- 5 Fifth order stream reach beginning at the junction of two fourth order streams and continuing downstream to the junction with the next fifth order stream.
- 6 Sixth order stream reach beginning at the junction of two fifth order streams and continuing downstream to the junction with the next sixth order stream.
- 7 Seventh order stream reach beginning at the junction of two sixth order streams and continuing downstream to the junction with the next seventh order stream.

W Water

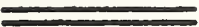


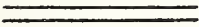
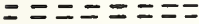





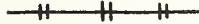




 Perennial stream that flows throughout the year.

 Intermittent stream that flows during wet seasons and is dry during dry seasons.

 Watershed Boundary

APPENDIX H

TRANSPORTATION FACILITIES MAP LEGEND

	Divided primary or heavy duty road with all weather, hard surface. Includes Federal and state highways maintained by the state.
	Primary or heavy duty road with all weather, hard surface. Includes Federal and state highways maintained by the state.
	Secondary or medium duty road with all weather, hard surface. Includes Federal and state roads maintained by the state.
	Light duty, all weather road with hard or improved surface.
	Unimproved dirt surface road.
	Road maintained by a Federal agency.
	Road maintained by the state.
	Road maintained by a city or county.
	Trail
	Railroad, single track
	Railroad, multiple track
	Landplane airport (improved)
	Landing area or landing strip (unimproved)
	Water
	Watershed Boundary

APPENDIX I

ROUNDING DATA AND METRIC CONVERSION FACTORS

Round all data on tables to nearest:

- 10 Acres
- 10 Hectares
- 1 Mile
- 1 Kilometer
- 0.1 Mile/Square Mile
- 0.1 Kilometer/Square Kilometer
- 0.1 Ton (English)/Acre
- 0.1 Ton (Metric)/Hectare
- 10 Tons (English)/Square Mile
- 10 Tons (Metric)/Square Kilometer

Rules for rounding (6):

If number is below middle value, then round down.

Examples: 1.49 miles to 1 mile
14.99 acres to 10 acres

If number is above middle value, then round up.

Examples: 1.51 miles to 2 miles
15.01 acres to 20 acres

If number is the middle value, then round to next even number.

Examples: 1.5 miles to 2 miles
2.5 miles to 2 miles
15.0 acres to 20 acres
25.0 acres to 20 acres

Factors for converting data on tables to metric units:

(0.4047) (Acres) = Hectares

(1.609) (Miles) = Kilometers

(0.6214) (Miles/Square Mile) = Kilometers/Square Kilometer

(2.24) (Tons (E)/Acre) = Tons (M)/Hectare

(0.35) (Tons (E)/Square Mile) = Tons (M)/Square Kilometer

MAPS



- LEGEND**
- NG Non-Irrigated Grazing
 - X Other
 - Home site
 - Watershed Boundary



MAP 1
LAND USE
MORLAR FLATS
208 PILOT STUDY AREA
FRESNO COUNTY
APRIL, 1978



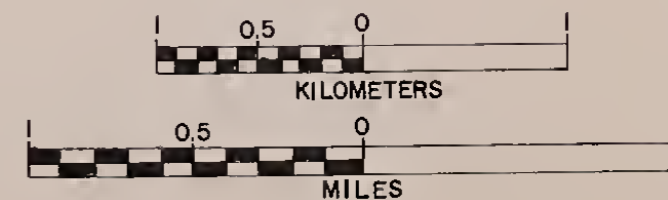
LEGEND

Soils judged to have a soil erodibility factor (K) value:

- .15 Of at least .13 but not more than .15
- .17 Of at least .16 but not more than .18
- .20 Of at least .19 but not more than .21
- .24 Of at least .22 but not more than .25
- .28 Of at least .26 but not more than .29
- .32 Of at least .30 but not more than .34
- .37 Of at least .35 but not more than .39
- Miscellaneous area not classified

— Watershed Boundary

MAP 2
"K" FACTOR MAP
MORLAR FLATS
208 PILOT STUDY AREA
FRESNO COUNTY
FEBRUARY, 1978





FRESNO COUNTY

PILOT STUDY AREA

LEGEND

Mean Annual Rainfall Intensity Factor (Rt)
Values:

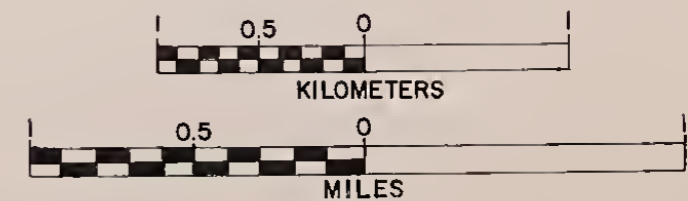
30 ——— Of at least 28 but not more than 34

40 ——— Of at least 35 but not more than 44

————— Watershed Boundary



MAP 3
"Rt" FACTOR MAP
MORLAR FLATS
208 PILOT STUDY AREA
FRESNO COUNTY
MARCH, 1978





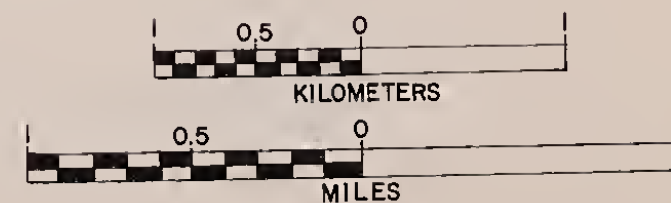
LEGEND

Areas in which the average slope of the land above horizontal ranges from:

- A 0-3 Percent
- B 3-9 Percent
- C 9-15 Percent
- D 15-30 Percent
- E 30-45 Percent
- F 45 Percent and Greater

— Watershed Boundary

MAP 4
SLOPE MAP
MORLAR FLATS
208 PILOT STUDY AREA
FRESNO COUNTY
APRIL, 1978





FRESNO COUNTY

PILOT STUDY AREA



LEGEND

Soils judged to have a soil-loss tolerance:

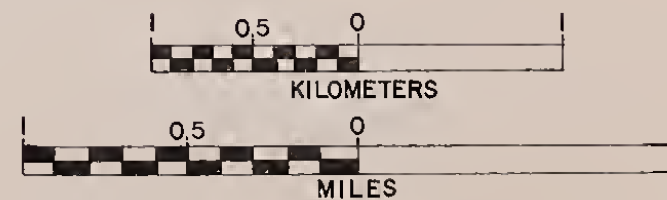
- 2 Of 2 tons per acre per year
- 3 Of 3 tons per acre per year
- 5 Of 5 tons per acre per year

□ Miscellaneous areas not classified

— Watershed Boundary

MAP 5 "T" FACTOR MAP MORLAR FLATS 208 PILOT STUDY AREA

FRESNO COUNTY
MARCH, 1978





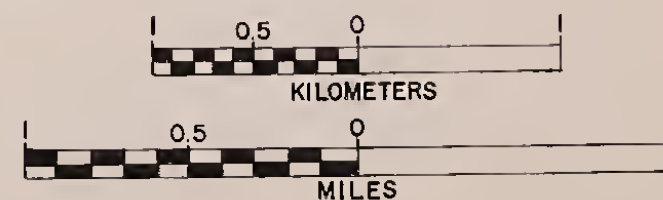


LEGEND

- Light Duty, All Weather Road
- Road Maintained by a City or County
- Landplane Airport
- Watershed Boundary



MAP 7 TRANSPORTATION FACILITIES MAP MORLAR FLATS 208 PILOT STUDY AREA

FRESNO COUNTY
DECEMBER, 1977

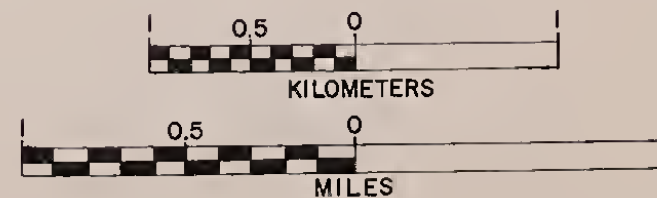




LEGEND

-  Sample Site Locations
-  Watershed Boundary

MAP 8
MACRO SAMPLE SITE MAP
MORLAR FLATS
208 PILOT STUDY AREA
FRESNO COUNTY
MARCH, 1978





FRESNO COUNTY

PILOT STUDY AREA

LEGEND

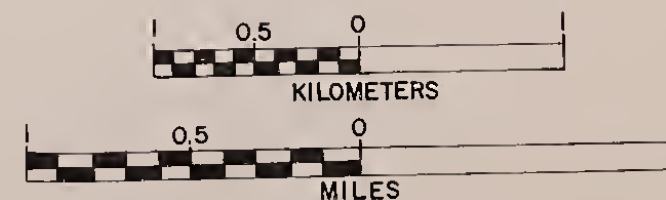
- Indexed Sample Site Locations
- Watershed Boundary



MAP 9 MICRO SAMPLE SITE MAP

MORLAR FLATS
208 PILOT STUDY AREA

FRESNO COUNTY
APRIL, 1978



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